


# City of Minneapolis Streetcar Feasibility Study

## Phase III Evaluation



# Overall Study Process

- 
- Develop **evaluation criteria** (complete)
  - **Field review** of candidate corridors (complete)
  - **Phase I:** Initial screening of candidate corridors (complete)
  - **Phase II:** Detailed evaluation of remaining corridors – selection of long-term network (complete)
  - **Phase III:** Detailed evaluation of shortest operable segments and refined capital & operating plans (this report)
  - **Financial plan** and **funding opportunities**
  - **Public input / open houses**

# Phase I Evaluation - Overview

- Evaluated 14 candidate corridors (that are part of the PTN) for technical and physical feasibility
  - Eliminated from further study those corridors that would require significant costs or are physically not feasible for streetcar
  - Ten corridors selected for further evaluation in Phase II



# Ten Corridors Carried Forward to Phase II Evaluation

<b>W Broadway Ave</b>	Entire corridor
<b>Central Ave NE</b>	South of 29th Ave NE only
<b>Chicago Ave S</b>	North of Lake only
<b>Franklin Ave</b>	Between Nicollet Ave S and Chicago Ave S
<b>Hennepin Ave S</b>	Entire corridor
<b>Lake St / Midtown Greenway</b>	West of Hiawatha Avenue only
<b>Nicollet Ave S</b>	Entire corridor (to 66th St)
<b>University Ave SE / 4th St SE</b>	Entire corridor
<b>Washington Ave</b>	Entire corridor
<b>Lyndale Ave S / Bryant Ave S</b>	North of Lake only

# Phase II Evaluation - Overview

**Ten corridors evaluated based on five broad criteria and several sub-criteria:**

## **Transit supportive land use**

- Special Use Generators and Corridor Anchors
- Transit Supportive Land Use

## **Economic Development Potential**

- Area Targeted for Redevelopment

## **Transit Operations**

- Speed and Reliability
- Relationship to other potential streetcar corridors
- Relationship to current/future high capacity transit investments
- Competition with LRT or BRT lines
- Replacement of existing bus service

## **Transit Demand**

- Projected (2020) Population Density Within Corridor
- Projected (2020) Employment Density Within Corridor
- Existing (2000) Low Income Household Density Within Corridor
- Existing (2000) Zero Car Household Density Within Corridor

## **Cost-Effectiveness**

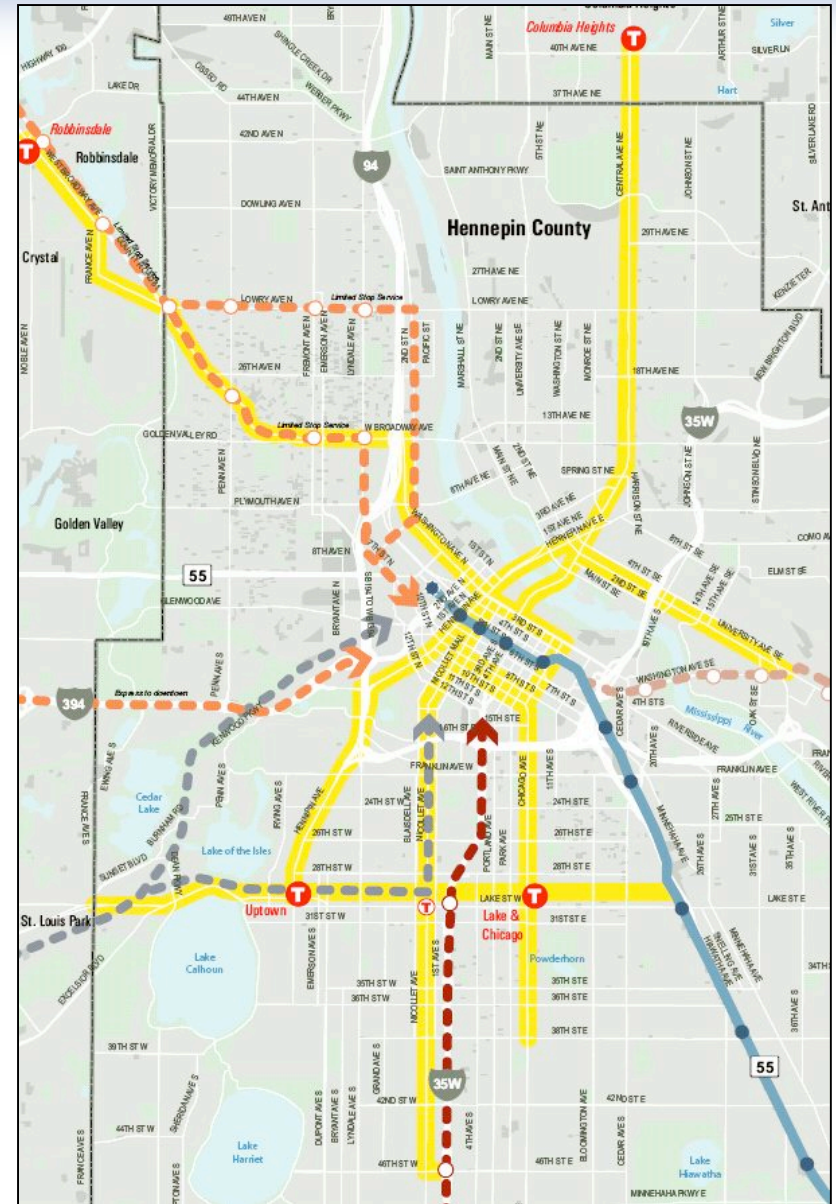
- Major utility conflicts
- Major capital cost items over standard streetcar construction cost



# Long-Term Streetcar Network

- **W Broadway**
  - To Robbinsdale TC
- **Central Ave NE**
  - To Columbia Heights TC
- **Chicago Ave S**
  - To 38<sup>th</sup> St
- **Hennepin Ave S**
  - To Lake (Uptown)
- **Midtown Greenway**
  - Between SW LRT / Hiawatha LRT
- **Nicollet Ave S**
  - To 46<sup>th</sup> St
- **University / 4<sup>th</sup>**
  - To Washington Ave at UM

*Long range vision; could be implemented over the next 20 or more years*



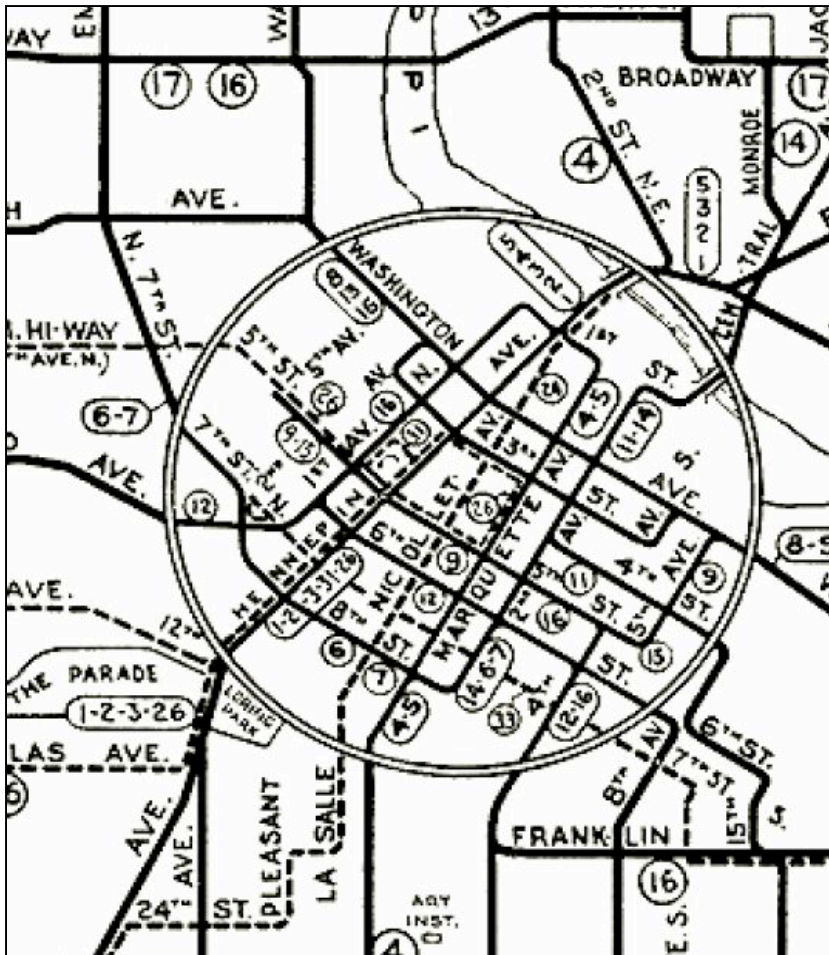
# Downtown Connections Between Long-Term Network Corridors



- **Broadway / Washington to Chicago** – via Nicollet
- **Broadway / Washington to Chicago** – via Park and Washington
- **Central to Nicollet** – via Nicollet
- **Central to Hennepin** – via Hennepin
- **Hennepin to University/4th** - via Hennepin



# Downtown Connections – Historical Context



- Many lines continued through downtown to other parts of the city
  - Few lines terminated in downtown
- Existing bus network based on historic streetcar network



## Phase III Evaluation - Goals

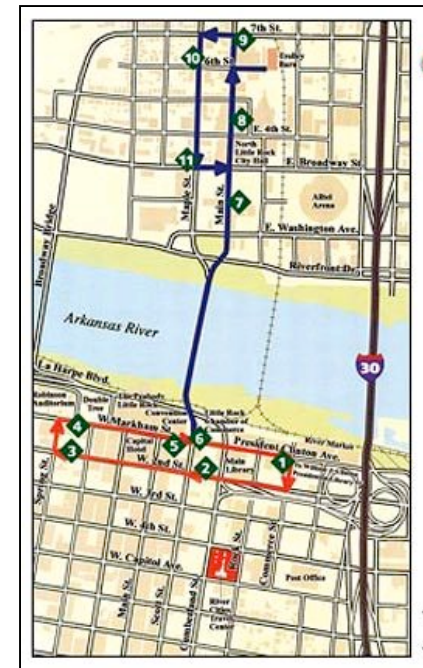
- Identify **“Shortest Operable Segments”**
  - Short segments (1-3 miles) that are the building blocks of the Long-Term Network
- **Refine operating plans, estimate ridership, and develop operating and capital cost estimates**
  - For both the Shortest Operable Segments and Long-Term Network
- Identify areas for **initial maintenance / storage facility**
- Begin to **identify potential sources of funding** (state, federal, local, etc)

# Shortest Operable Segments

## Identifying which segments to implement first

- Most initial streetcar lines (and extensions) have been relatively short:

City	Segment	Year Implemented	Route Miles	Track Miles
Portland, OR	(NW 23 <sup>rd</sup> Ave to Portland State University)	2001	2.4	4.8
	(Portland State University to Riverplace)	2005	0.6	1.2
	(Riverplace to SW Gibbs)	2006	0.9	0.9
	(SW Gibbs to SW Lowell)	2007	0.4	0.8
	<b>Total</b>		<b>4.3</b>	<b>7.7</b>
Tacoma, WA	(LINK Light Rail)	2003	1.0	2.4
Little Rock, AK	(Downtown to N. Little Rock)	2004	2.5	2.5
	(Clinton Library Extension)	2007	0.5	1.0
	<b>Total</b>		<b>2.5</b>	<b>3.5</b>
Memphis, TN	(Main Street)	1993	2.5	5.0
	(Riverfront Loop)	1997	2.5	2.5
	(Madison Line)	2004	2.2	4.4
	<b>Total</b>		<b>7.2</b>	<b>11.9</b>
Tampa, FL	(TECO Line)	2003	2.4	3.2



*Little Rock* 10

# Shortest Operable Segments

## Identifying which segments to implement first

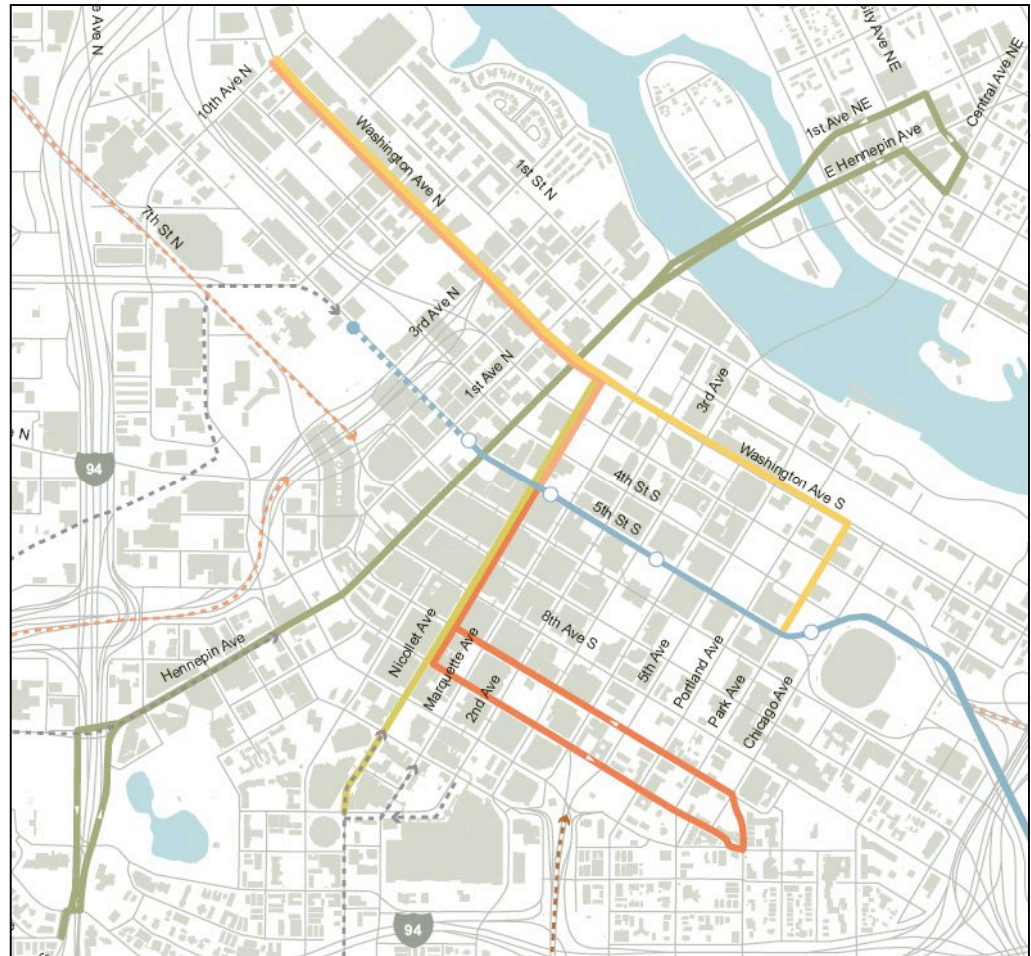
- Several guidelines were used to select Shortest Operable Segments:
  - Avoid segments that conflict with other decisions (e.g., Metrodome, SW Corridor LRT, new Twins stadium)
  - Initial line needs to be successful from the beginning
  - Avoid major capital costs
  - Ensure that initial segment leads to Long-Term Network



# Shortest Operable Segments

The following initial segments were identified:

- **Hennepin Avenue** from Groveland to E. Hennepin and University/4th.
- **Broadway/Washington Avenue** from 10th Ave N to Nicollet Ave/5th Street (LRT station)
- **Broadway/Washington Avenue** from 10th Ave N to Park Ave/5th Street (LRT Station)
- **Nicollet Avenue** from Grant Avenue (Convention Center) to Washington Avenue
- **9th/10th Streets and Nicollet Avenue** from 14th Street/Chicago Avenue to Nicollet Avenue/Washington Avenue



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# Shortest Operable Segments

## Refined Operating Plans

- Several variables required to develop operating plans:
  - Corridor length
  - Travel speed
  - Layover requirement (15% of revenue hours)
  - Frequency of service (assumes min. 15 min)
  - Hours and days of service (assumes min. 16 hours/day weekday, 14 hours/day weekend)
- Based on these inputs, “planning level” estimates were made of:
  - Total annual revenue hours
  - Fleet requirement
  - Annual operating cost \*



\*Assumes operating cost per revenue hour of \$150/hour (approximately 50% higher than Metro Transit bus but lower than LRT)



# Shortest Operable Segments

## Travel Speed and Operation in Mixed Traffic

- Similar to bus – streetcar in Toronto and Portland frequently operate in highly congested, mixed traffic corridors.



*Toronto*



*Portland*



# Shortest Operable Segments

## Operating Cost Estimates

(Assumes 15 minute headways; 14-16 hours/day)

<b>Shortest Operable Segment</b>	<b>Route Miles</b>	<b>Peak Vehicles</b>	<b>Annual Revenue Hours</b>	<b>Annual Operating Cost</b>
Hennepin	2.6	3	17,172	\$2,572,000
Broadway / Washington -via Nicollet	1.2	2	11,448	\$1,714,000
Broadway / Washington -via Park	1.7	2	11,448	\$1,714,000
Nicollet	1.0	2	11,448	\$1,714,000
9 <sup>th</sup> / 10 <sup>th</sup> / Nicollet	1.3	2	11,448	\$1,714,000

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# Long-Term Network

## Refined Operating Plans



- Several possible strategies were used to refine the operating plans for the Long-Term Network:
  - Replace bus trips entirely with streetcar
  - Operate limited stop bus service in the same corridor as streetcar
  - *Terminate bus service at major terminal, transfer to streetcar*
  - No change to underlying bus network

### NOTES:

- *Operating plans did not include major route restructuring*
- *Operational efficiencies are likely when the entire network is complete. These efficiencies are not factored in at this time.*

# Long-Term Network

## Estimated Impact on Total Operating Costs

Corridor	Streetcar Service Hours	Annualized Streetcar Operating Cost (1)	Estimated Reduction in Bus Revenue Hours	Annualized Reduction in Bus Operating Cost (2)	Adjusted Annualized Change in Operating Cost
W Broadway / Washington	34,380	\$5,148,000	19,600	\$1,957,000	<b>\$3,191,000</b>
Central Ave NE / 3 <sup>rd</sup> Ave	39,561	\$5,924,000	34,100	\$3,404,000	<b>\$2,520,000</b>
Chicago Ave S / 9 <sup>th</sup> /10 <sup>th</sup> St	45,547	\$6,821,000	16,100	\$1,607,000	<b>\$5,214,000</b>
Hennepin Ave S / Univ.-4th	45,804	\$6,859,000	24,000	\$2,396,000	<b>\$4,463,000</b>
Midtown Greenway	19,710	\$2,952,000	0	\$0	<b>\$2,952,000</b>
Nicollet Ave S	47,305	\$7,084,000	43,600	\$4,353,000	<b>\$2,731,000</b>

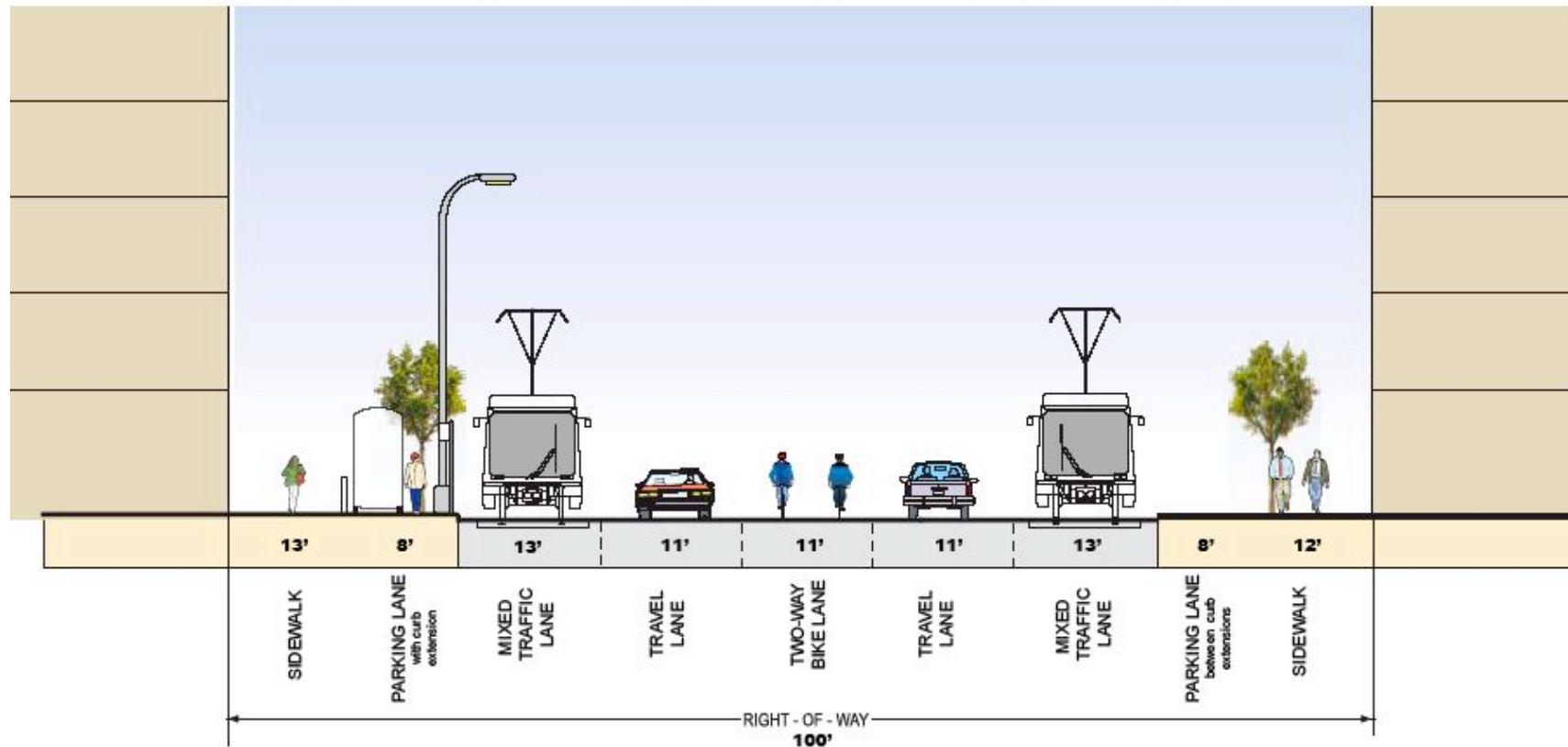
(1) Assumes \$149.75 per revenue hour (2) Assumes Metro Transit's cost per revenue hour of \$99.83 (2005)

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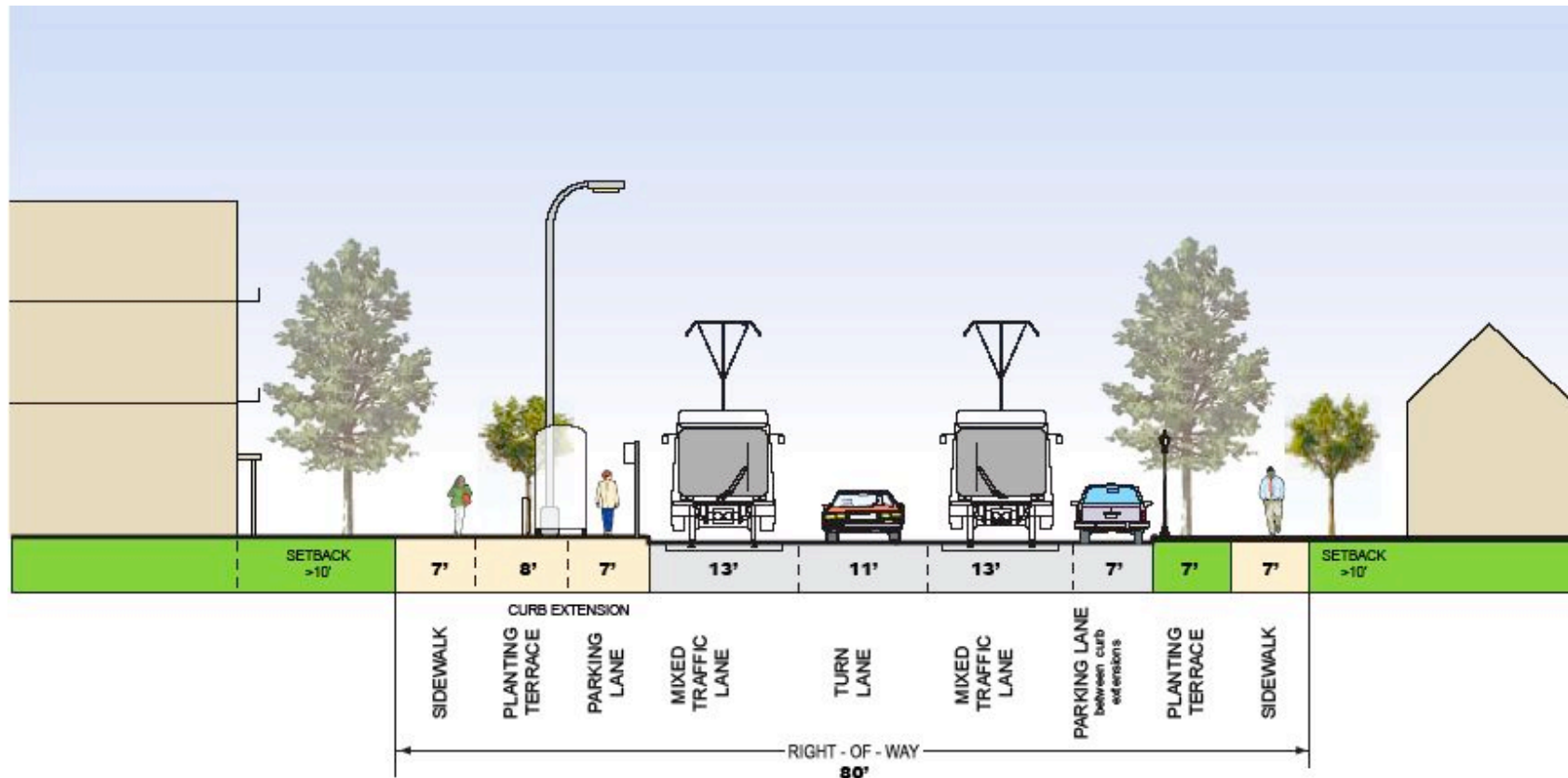
# Streetcar Cross Sections

## Hennepin Avenue - Downtown



# Streetcar Cross Sections

## Typical Community Corridor



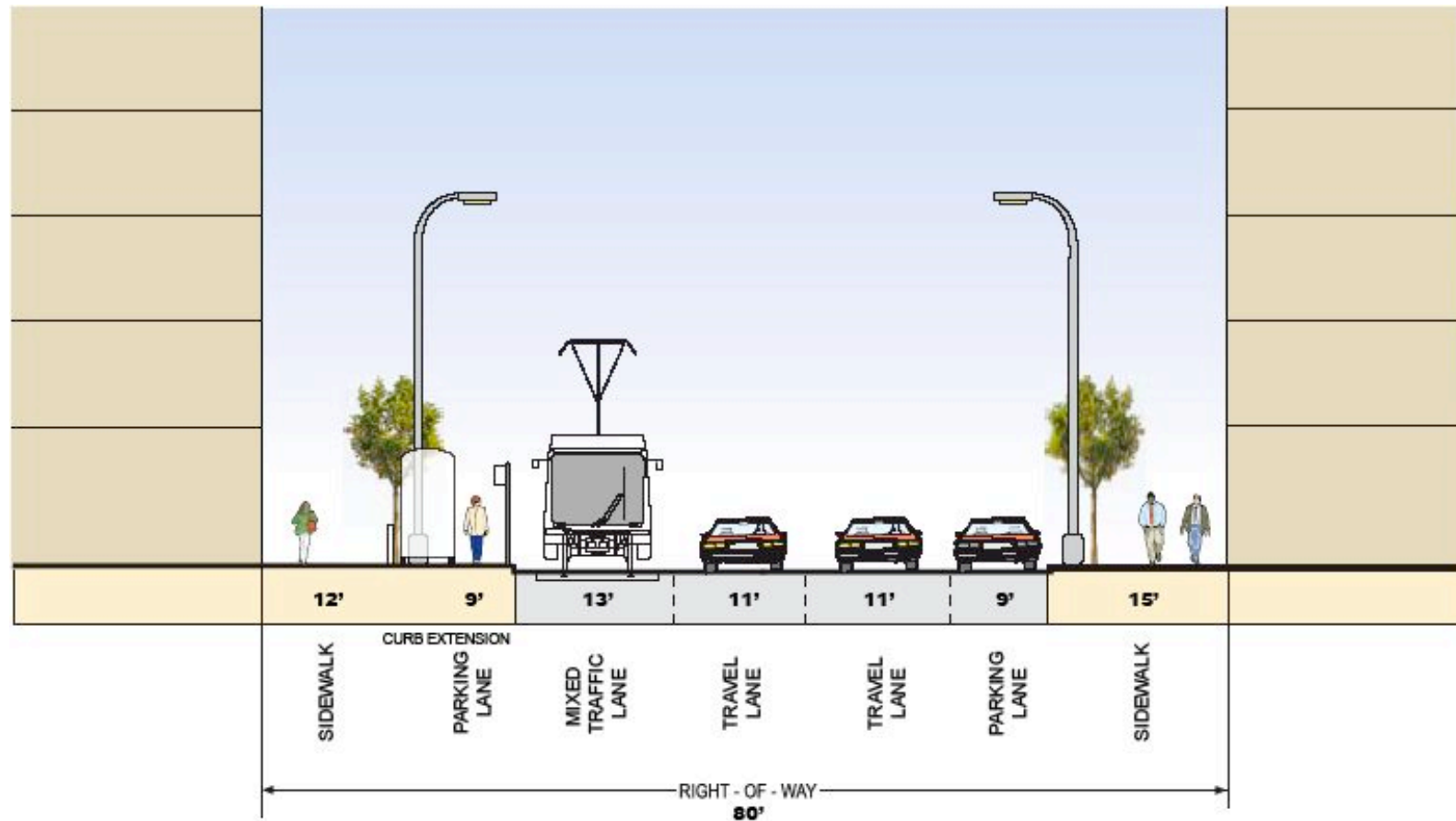
# Streetcar Cross Sections

## Typical Community Corridor



# Streetcar Cross Sections

## Typical One-Way Street - Downtown



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# Streetcar Cross Sections

## Typical One-Way Street - Downtown



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# Ridership Estimates

- Eight major factors influence ridership:
  - Population and employment density
  - Intensity and mix of land uses
  - Travel time (speed and boarding)
  - Frequency
  - Fares and Fare Policy
  - Connectivity to a larger network
  - Legibility
  - Comfort and ride quality

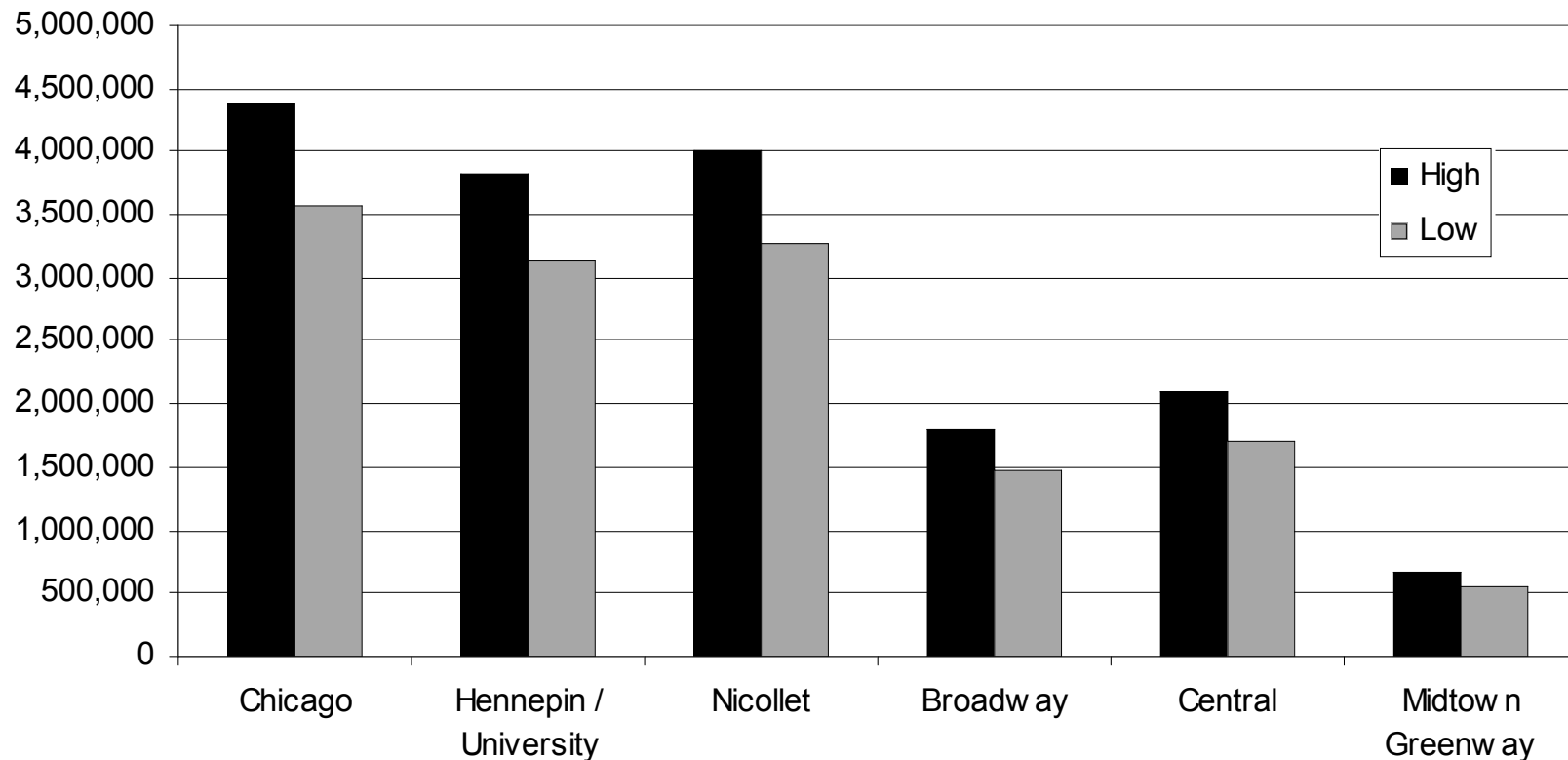


# Ridership Estimates

- Long-Term Corridors
  - “Pivoted” off existing bus productivities (passengers per revenue hour)
  - Increased or decreased based on the eight factors that influence ridership
- Shortest Operable Segments
  - Based on productivities of other short streetcar segments
    - Tampa, Little Rock, Portland, Tacoma
  - Adjusted up or down for each segment based on:
    - Intensity of land use
    - Proportion of line in the downtown fare zone
- Some adjustments may occur to these figures

# Annual Ridership Estimates

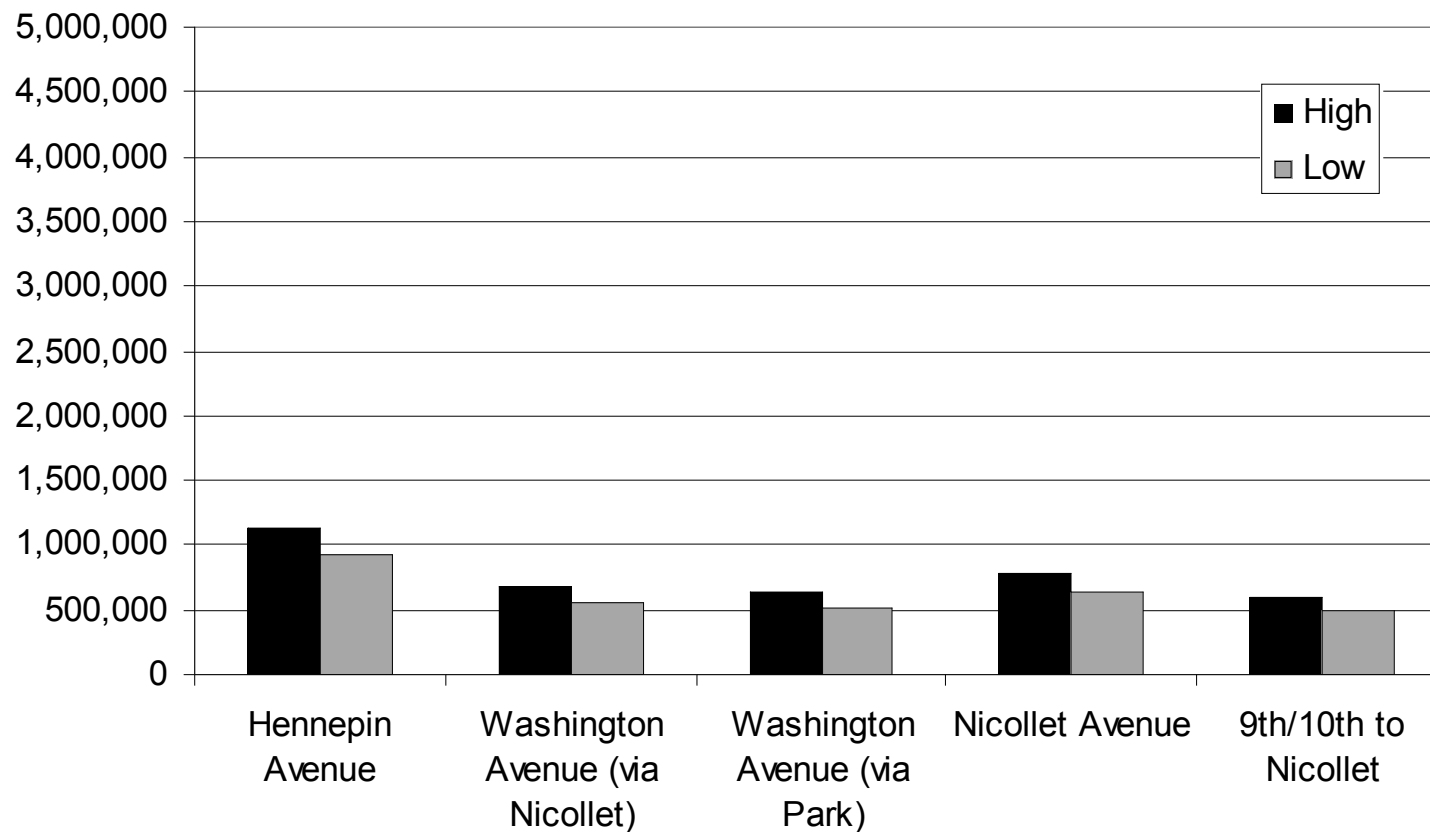
- Long-Term Corridors





# Annual Ridership Estimates

- Shortest Operable Segments



# Capital Cost Estimates

- Estimates based on a standard cost per mile
  - Trackwork
  - Platforms
  - Overhead power / substations
  - Utilities
  - Switches
  - Engineering / project management
  - Contingency
- Other major capital costs
  - Bridges
  - Vertical circulation (Greenway only)
- Not included in initial estimates:
  - Vehicles
  - Maintenance / storage facility



# Capital Cost Estimates

- Order of Magnitude Capital Costs per Track Mile

<b>COST CATEGORY</b>	<b>Unit Cost (\$2007)</b>	<b>Quantity</b>	<b>Total Cost per Track Mile</b>
Trackwork - Track Slab Installation	\$420	5,280	\$2,217,600
Power	\$228	5,280	\$1,203,840
Switch	\$18	5,280	\$95,040
Utilities - Moderate Conflicts	\$360	5,280	\$1,900,800
Platforms	\$60,000	5	\$300,000
Construction Soft Costs	20%	Of cost	\$1,143,456
<b>SUB-TOTAL CONSTRUCTION COST</b>	-	-	\$6,860,736
Engineering and Project Management	20%	Of sub-total	\$1,372,147
General Contingency	25%	Of sub-total	\$1,715,184
<b>TOTAL ANTICIPATED CONSTRUCTION COST (\$2007)</b>	-	-	<b>\$9,948,067</b>

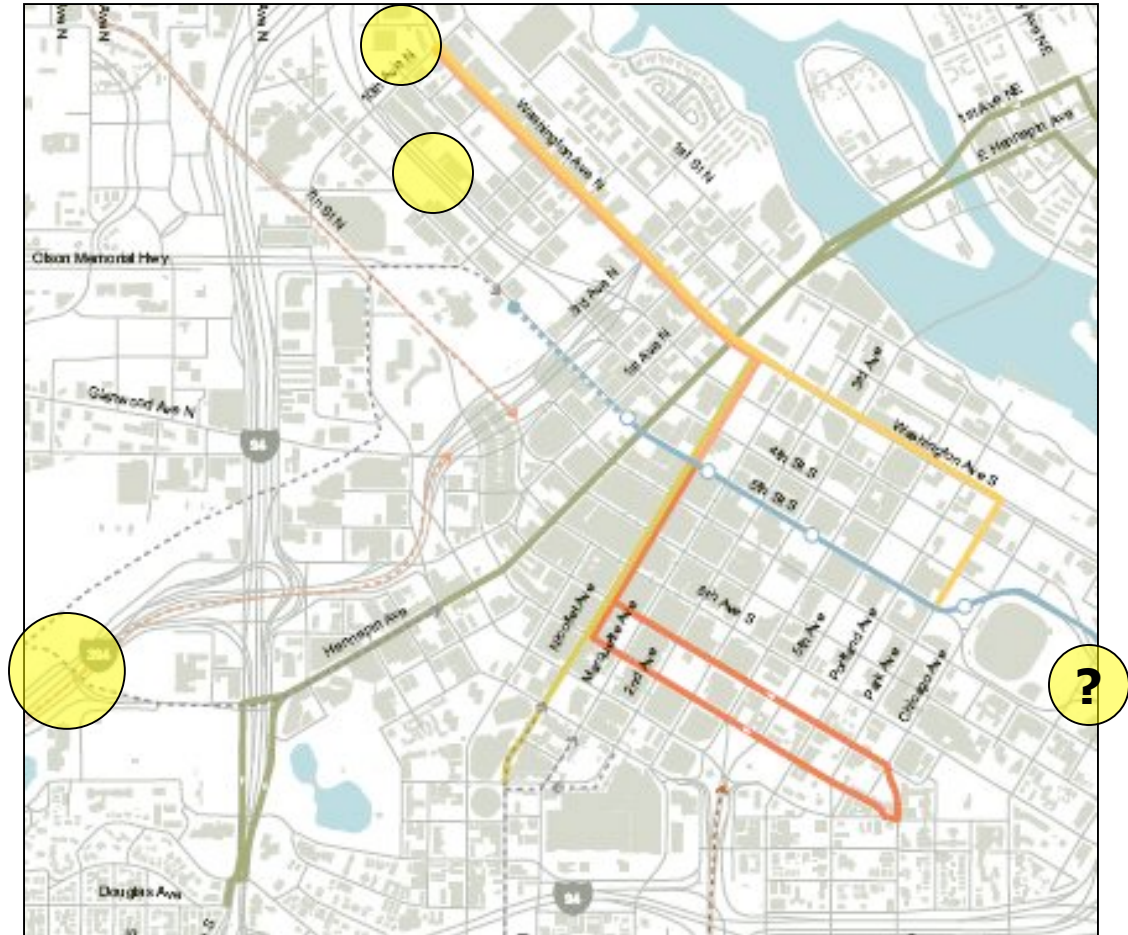
# Capital Cost Estimates

Segment	Corridor	From...	To...	Track Miles	Cost per Track Mile (see Figure 6-1)	Basic Cost	Major Capital Items	Major Capital Costs	Total Capital Cost (excluding vehicles and maintenance facility)
1-A	Hennepin	Groveland / Hennepin	University / 4th / Central	4.8	\$9,948,067	\$47,750,722	1) Lowry Tunnel 2) Hennepin Bridge (Miss. River) 3) Center Stations (Wash – 10 <sup>th</sup> ) 4) LRT Crossing	\$244,000 \$2,080,000 \$450,000 \$50,000	\$50,574,722
1-B	Hennepin	Groveland / Hennepin	Lake / Hennepin	3.0	\$9,948,067	\$29,844,201	1) Greenway Bridge	\$120,000	\$29,964,201
2-A	University/4th	University / 4th / Central	Washington / University	3.6	\$9,948,067	\$35,813,041	1) I-35W Bridge 2) Dinkytown Bridge	\$400,000 \$440,000	\$36,653,041
3-A	Broadway/Washington	10th Ave N / Washington	Nicollet / Washington	1.8	\$9,948,067	\$17,906,521	1) 4 <sup>th</sup> Avenue Railroad Bridge	\$70,000	\$17,976,521
3-B	Broadway/Washington	Nicollet / Washington	Nicollet / 5th St	0.4	\$9,948,067	\$3,979,227	1) LRT Crossing 2) Mall Modifications	\$50,000 \$300,000	\$4,329,227
3-C	Broadway/Washington	Nicollet / Washington	Chicago / 5th (1)	1.6	\$9,948,067	\$15,916,907	1) LRT Crossing	\$50,000	\$15,966,907
3-D	Broadway/Washington	10th Ave N / Washington	North Memorial Hosp.	6.2	\$9,948,067	\$61,678,015	1) I-94 Bridge	\$660,000	\$62,338,015
3-E	Broadway/Washington	North Memorial Hosp.	Robbinsdale TC	3.4	\$9,948,067	\$33,823,428	-	\$0	\$33,823,428
4-A	Chicago	Nicollet / 5th	14th St / Chicago	2.2	\$9,948,067	\$21,885,747	-	\$0	\$21,885,747
4-B	Chicago	Park / 5th	14th St / Chicago	1.0	\$9,948,067	\$9,948,067	-	\$0	\$9,948,067
4-C	Chicago	14th St / Chicago	Chicago / Lake	2.8	\$9,948,067	\$27,854,588	1) I-94 Bridge 2) Greenway Bridge	\$660,000 \$180,000	\$28,694,588
4-D	Chicago	Chicago / Lake	Chicago / 38th	2.0	\$9,948,067	\$19,896,134	-	\$0	\$19,896,134
5-A	Nicollet	Nicollet / 5 <sup>th</sup> St	Nicollet / Grant	1.4	\$9,948,067	\$13,927,294	1) Mall Modifications	\$1,800,000	\$15,727,294
5-B	Nicollet	Nicollet / Grant	Nicollet / Lake	2.8	\$9,948,067	\$27,854,588	1) I-94 Bridge 2) K-Mart Bridge	\$400,000 \$200,000	\$28,454,588
5-C	Nicollet	Nicollet / Lake	Nicollet / 46th	4.0	\$9,948,067	\$39,792,268			\$39,792,268
6-A	Central	Nicollet / Washington	1st Ave NE / University	2.0	\$9,948,067	\$19,896,134	1) 3 <sup>rd</sup> Ave Bridge (Miss. River)	\$3,800,000	\$23,696,134
6-B	Central	Central / 4th St SE	Central / 29th Ave NE	4.8	\$9,948,067	\$47,750,722	1) 9 <sup>th</sup> Street NE RR Bridge 2) Broadway Street NE Bridge	\$300,000 \$440,000	\$48,490,722
6-C	Central	Central / 29th Ave NE	Columbia Heights TC	2.8	\$9,948,067	\$27,854,588	1) 36 <sup>th</sup> Ave NE RR Crossing	\$50,000	\$27,904,588
7-A	Midtown Greenway	West Lake Station	Hennepin	2.4	\$9,948,067	\$23,875,361	1) Side Track – (1) 2) Elevators – (1)	\$620,000 \$200,000	\$24,695,361
7-B	Midtown Greenway	Hiawatha / Lake Station	Chicago	2.6	\$9,948,067	\$25,864,974	1) Side Track – (1) 2) Elevators – (2)	\$620,000 \$400,000	\$26,884,974
7-C	Midtown Greenway	Chicago	Hennepin	3.6	\$9,948,067	\$35,813,041	1) Side Track – (1) 2) Elevators – (2)	\$620,000 \$400,000	\$36,833,041
7-D	Midtown Greenway	Hiawatha / Lake Station	28th St Station	4.4	\$9,948,067	\$43,771,495	1) Side Track – (1) 2) Elevators – (2)	\$620,000 \$400,000	\$44,791,495



# Maintenance / Storage Facility

- General areas identified that may be appropriate
- Key functions include:
  - Vehicle Storage
  - Equipment and Parts Storage
  - Administrative Functions
  - Employee Parking
  - Vehicle Cleaning (interior and exterior)
  - Daily Inspections
  - Preventative Maintenance
  - Running Repairs
- Cost between \$2-4 million
- Storage for up to 10 vehicles



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# Maintenance Facility and Vehicles

- Maintenance / storage facility
  - Only required for first line
  - Cost (\$2-4 million)
- Vehicles
  - Includes in-service and spare vehicles
    - 1 spare for each shortest operable segment
    - 15-20% ratio for long-term network
  - Cost per vehicle
    - ~\$3.0 million



# Summary of Phase III Evaluation

	Hennepin Avenue	Broadway/Washington Avenue to Nicollet Avenue	Broadway/Washington Avenue to Park Avenue	Nicollet Avenue	9 <sup>th</sup> /10 <sup>th</sup> Streets to Nicollet Avenue
From	Groveland	10 <sup>th</sup> Avenue N	10 <sup>th</sup> Avenue N	Grant Avenue	Chicago Avenue / 14 <sup>th</sup> Street
To	Central Ave NE/4 <sup>th</sup> Street SE	5 <sup>th</sup> Street / Nicollet Avenue	5 <sup>th</sup> Street / Park Avenue	Washington Avenue	Nicollet Avenue / 5 <sup>th</sup> Street
<b>Operating Characteristics</b>					
Peak Vehicle Requirement	3	2	2	2	2
Annual Service Hours	17,200	11,450	11,450	11,450	11,450
Estimated Annual Operating Costs (assuming \$149.75/hour)	\$2,571,507	\$1,714,338	\$1,714,338	\$1,714,338	\$1,714,338
<b>Ridership Estimates</b>					
Estimated Weekday Ridership – Low	2,357	1,312	1,226	1,747	1,139
Estimated Weekday Ridership – High	2,885	1,603	1,498	2,138	1,392
Estimated Annual Ridership – Low	831,449	461,916	431,460	616,226	401,004
Estimated Annual Ridership – High	1,016,215	564,564	527,340	753,166	490,116
<b>Capital Cost Estimates (\$2007)</b>					
Route Miles	2.6	1.2	1.7	1.0	1.3
Track Miles	4.8	2.2	3.4	1.8	2.6
Estimated Cost per Track Mile	\$9,948,067	\$9,948,067	\$9,948,067	\$9,948,067	\$9,948,067
Subtotal	\$47,750,722	\$21,885,747	\$33,823,428	\$17,906,521	\$25,864,974
Additional Capital Costs	1) Lowry Tunnel - \$244,000 2) Hennepin Bridge (Miss. River) - \$2.08 M 3) Center Stations (Wash – 10th) - \$450,000 4) LRT Crossing - \$50,000	1) 4 <sup>th</sup> Avenue N Bridge - \$70,000 2) LRT Crossing - \$50,000 3) Mall Modifications - \$300,000	1) 4 <sup>th</sup> Avenue N Bridge - \$70,000 2) LRT Crossing - \$50,000	1) LRT Crossing - \$50,000 2) Mall Modifications - \$2,100,000	1) LRT Crossing - \$50,000
Vehicle Costs <sup>a</sup>	\$12,000,000	\$9,000,000	\$9,000,000	\$9,000,000	\$9,000,000
Non-revenue track <sup>10</sup>	\$4,459,479	\$4,459,479	\$4,459,479	\$4,459,479	\$4,459,479
Maintenance Facility <sup>11</sup>	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
<b>Total Capital Costs (\$2007)</b>	<b>\$70,790,201</b>	<b>\$39,765,226</b>	<b>\$51,402,907</b>	<b>\$37,516,000</b>	<b>\$43,374,453</b>
<b>Cost Effectiveness Measures</b>					
Capital Cost per Passenger – High	\$69.66	\$70.44	\$97.48	\$49.81	\$88.50
Capital Cost per Passenger – Low	\$85.14	\$86.09	\$119.14	\$60.88	\$108.16
Operating Cost per Passenger – High	\$3.09	\$3.71	\$3.97	\$2.78	\$4.28
Operating Cost per Passenger – Low	\$2.53	\$3.04	\$3.25	\$2.28	\$3.50
<b>Service Efficiency Measure</b>					
Passengers per Service Hour – High	60.1	50.1	46.8	66.8	43.5
Passengers per Service Hour – Low	49.1	41.0	38.3	54.6	35.6

# Next Steps

- Gauge community support
  - Public open house meetings
- Gauge political support
- Evaluate impact on local bus network
  - Especially downtown
- Identify most likely public and private funding sources
  - Work has already begun on identifying potential sources
- Gauge support from developers
- Identify corridors that are programmed for other street improvements



# Photos



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# Photos



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# Photos



# Photos



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# Photos



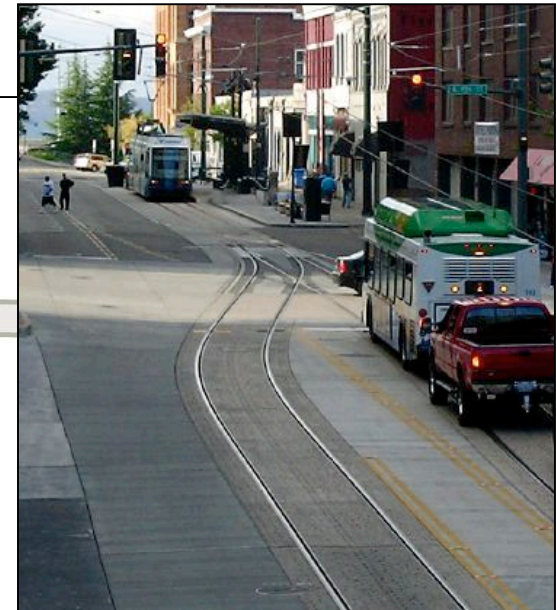
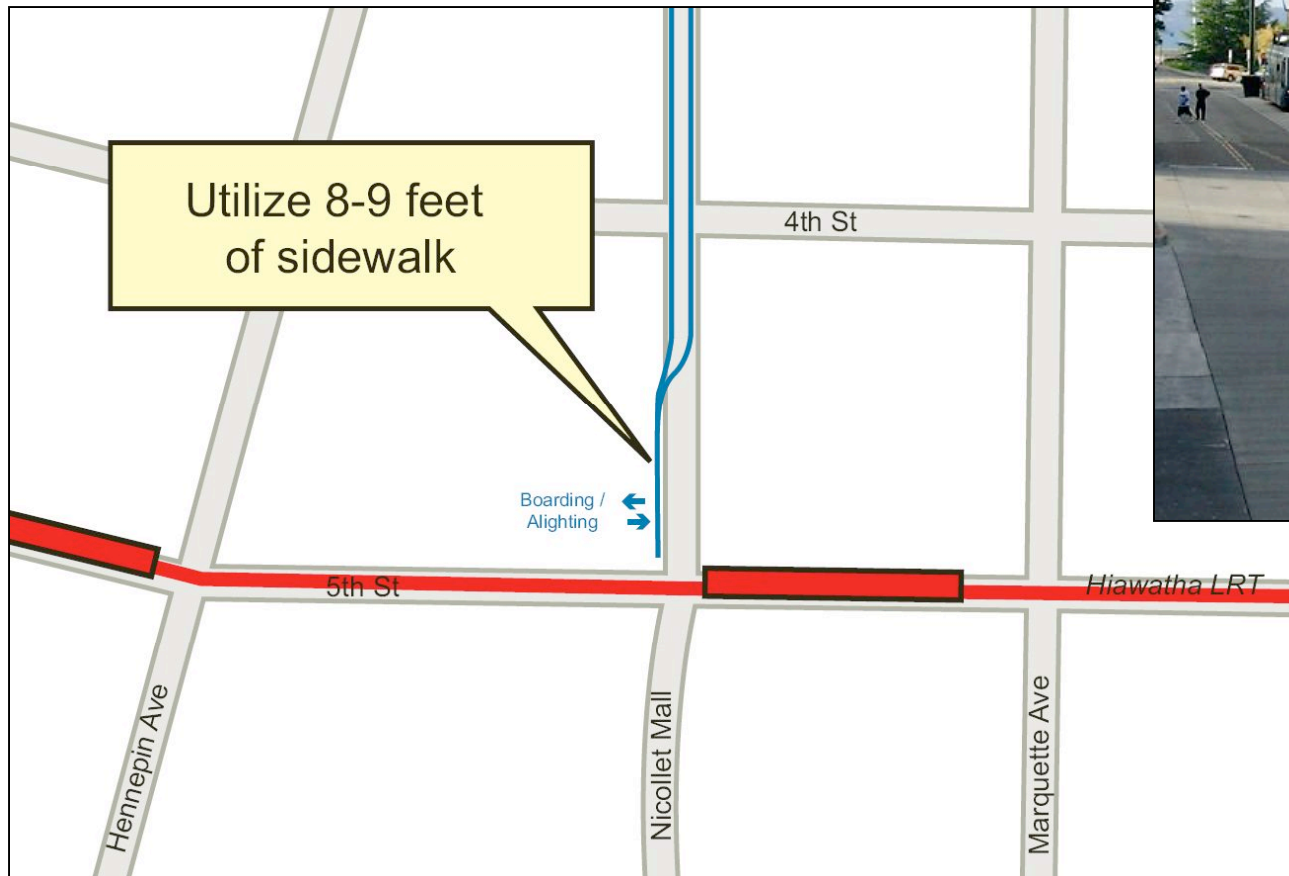
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# Photos



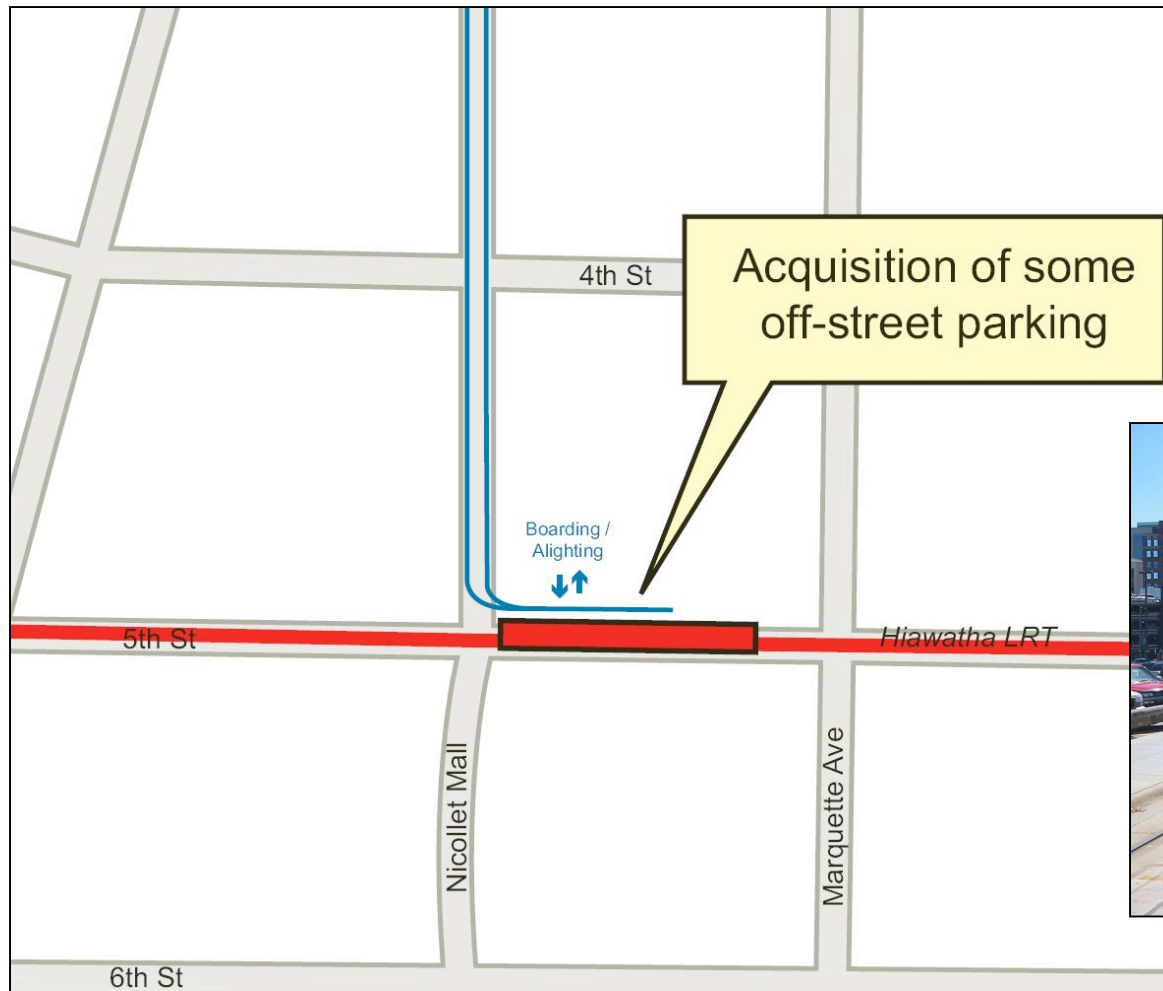
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# Nicollet Alignment





# Nicollet Alignment



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